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OUTPUT OF OVER-AGE DRY BATTERIES

The lack of an adequate supply of dry batteries for the civilian market has fostered the sale of over-age batteries which are no longer desired for military purposes. This has given rise to considerable interest in information which the Bureau has accumulated on the deterioration of batteries in storage. The qualification tests regularly made at the Bureau in connection with Government purchases of dry cells and batteries have given a large amount of information regarding the performance of cells after storage periods of 3 and of 6 months. Reports summarizing the results of such tests made during recent years have been supplied to a number of Government agencies, including the Office of Price Administration. The amount of depreciation naturally varies considerably among the different types and sizes of cells and the conditions under which they are stored, but cells of good quality of most types after 6-months' storage will give at least 80 to 90 percent of the output of new cells. The smallest size which the public buys, however, may range from 60 to 70 percent. Sample lots of dry cells now available on the market are being tested for the Office of Price Administration.

AN AID TO THE MEASUREMENT OF SHRINKAGE OF HOSE-RIERY

Recent work at the Bureau for the military services on shrinkage of men's socks required the measurement of dimensions of socks not only in the relaxed condition—that is, without tension—but when stretched under loads comparable to those to which socks may be subject in use. It was recognized that changes in the dimensions of the sock in laundering are not important if the sock readily accommodates itself to the size of the foot of the wearer and does not bind or become baggy. But if the sock shrinks and felts in laundering and fits too snugly, or if it becomes too loose-fitting, it is uncomfortable, wears at an excessive rate, and is discarded.

Accordingly, a new device for measuring the dimensions of the foot of socks and other hosiery under different loads was developed in the Bureau's Textile Section. It has proved of value in the study of shrink-proofing treatments and effects of fiber composition and methods of laundering on the shrinkage of socks; the Quartermaster Corps is having a number built for its use.

The device is a flat metal form having the shape of a boarded sock. It is made in two parts. One part includes the

¹ Published with approval of the Director of the Budget.

region of the toe and has a flat extension the full width of the foot which slips between the faces of the second part of the form. Thus it is possible to draw out the foot of the form to fill socks of different sizes, for the width of the foot of flattened socks is the same for different sizes. The second part of the form, which includes the rest of the foot, heel, and ankle, is provided with means for attaching it to the pulling member of a tensile testing machine and with a clamp for holding a sock on the form.

In carrying out a test the sock is placed on the form and clamped at a fixed position across the ankle. Another clamp is attached to the toe by means of a pin which passes through the sock and through a hole in the form near the toe. This clamp is attached to the weighing mechanism of the tensile machine. The length of the sock at different loads without reduction in width is obtained from the stress-strain record of the machine. By testing socks before and after laundering, changes in dimensions at stated loads may be evaluated. Similarly, socks may be loaded and unloaded repeatedly, and the accompanying changes in dimensions at stated loads may be measured.

The device may be used without the tensile testing machine by attaching one end to a rigid support and adding weights to the other while it is hanging freely, and measuring the length of the sock on it.

Changes in width of foot or of welt are measured with equipment previously developed at the Bureau (NBS Circular C422, Methods of Testing Hosiery, page 15).

THERMAL PROPERTIES OF MOIST FABRICS

Practical experience has demonstrated that moist fabrics in contact with the body produce an unpleasant sensation commonly referred to as a "chilling effect," or a "clammy feel." The degree of the sensation varies with different fibers and fabrics; thus, on the basis of general experience, the merits of wool fabrics over similar cotton fabrics have long been recognized. This is one of the reasons, for example, for the preference usually given to woolen underwear and other garments for use in cold climates under conditions where physical labor causes considerable perspiration. It also accounts for the approval commonly expressed for woolen bathing suits. In order to obtain factual data to explain these preferences, and to evaluate the

various factors which contribute to the chilliness, or clamminess, of wet fabrics, an investigation of this phenomenon was undertaken by Charles W. Hock, Arnold M. Sookne, and Milton Harris, research associates of the Textile Foundation at the Bureau.

As reported in the May number of the Journal of Research (RP1587), a good qualitative relation was found among subjective tests, measurement of the drop in temperature which ensues when wet fabrics are placed on a skin surface, and tests to measure the extent of contact which the fabrics make with the skin. Fabrics which produced considerable chilling in subjective tests were found to make good contact and to cause a substantial drop in skin temperature. On the other hand, fabrics which caused little or no clamminess made poor contact, and the accompanying drop in temperature was relatively small.

From the results of these experiments on fabrics of a variety of constructions and fiber compositions, several important conclusions can be drawn. Thus, for example, the progressive improvement of the fabrics as their wool content is increased, and the superiority of some types of construction which minimize the extent of contact of the fabrics with the skin, are clearly indicated.

EFFECT OF HUMIDITY ON PHYSICAL PROPERTIES OF PAPER

Paper is very sensitive to changes in the atmosphere, particularly to changes in relative humidity. As the atmosphere becomes humid, paper absorbs moisture which is given up again in dry air. Many of the physical characteristics or properties of paper are altered by this ebb and flow of moisture. The extent to which various papers are affected by given amounts of change in atmospheric humidity and temperature has been determined.

A rather extensive study of this character was made a number of years ago at the Bureau, but unfortunately the report of this work has long been out of print. The essential data are being published again as Circular C445 by Frederick T. Carson. This contains a number of tables and graphs which show the variation with humidity of the weight per unit area, the bursting strength, the tearing resistance, the folding endurance, the tensile strength, and the stretch to failure in tension. This information is supplemented by a number of references to other published reports on the same subject.

Copies of C445 are obtainable from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. The price is 5 cents.

INFLUENCE OF METALLIC DRIERS ON LINSEED-REPLACEMENT OILS

With the object of conserving drying oils used in protective coatings, the War Production Board, through its Conservation Order M-332, as amended October 6, 1943, specified the maximum amount of certain oils allowed in the formulation of paints, varnishes, etc., for civilian use. The quantities set forth in this order are appreciably lower than the amounts customarily used in such commodities. Linseed-replacement oil, consisting of bodied linseed oil, raw linseed oil, and thinners, with or without driers, was designed as a complete vehicle to replace linseed oil in the adjusted formulations necessitated by the order. Federal Specification TT-P-371, as amended March 17, 1944, covers two types of linseed-replacement oils—Type I oil contains driers, whereas no driers are added to type II oil.

Fifty oils of known composition were prepared, and the effect of various metallic driers on their clarity, kauri reduction, acid number, and set-to-touch time was studied.

In general, driers lower the percentage of kauri reduction that this type of material will withstand. Drier combinations containing the same amount of the respective metals give similar results whether they are of the same type or a mixture of types. Lead driers cause the least change in kauri reduction values, and manganese driers the greatest, with the values of cobalt falling in between. Lead-cobalt driers yield higher kauri reduction values than do either lead-manganese or cobalt-manganese driers. Increasing the amount of drier within reasonable working limits tends to decrease the percentage of kauri reduction the oil will withstand. On the other hand, the set-to-touch time is somewhat shortened.

Manganese driers, when used alone, appreciably increase the acid value of the oil, whereas very little change is effected when they are used with lead or cobalt driers or combinations of the two. Lead driers separate from the oil in a relatively short time. The presence of small amounts of calcium tends to hold the lead in solution but does not necessarily insure against its separation.

A bodied oil of high acid value may be expected to have a higher kauri re-

duction than one of the same viscosity, which has a low acid value. Either mineral spirits, turpentine, or a mixture of these may be used as a thinner for replacement oils without changing their properties except for slight variations in their viscosities.

PERMEABILITY OF CONCRETE TO KEROSENE

The increased wartime use of concrete tanks for storing Diesel oils, light fuel oils, and gasoline induced the Bureau to undertake a limited investigation of methods for rendering concrete adequately impermeable to these products. Measurements were made by F. B. Hornibrook of the daily inflow of kerosene under a 12-ft pressure head into one face of specially treated concrete disks.

The penetration of kerosene into 14-day-old untreated concrete was relatively low but after the concrete dried for 6 weeks the penetration was high. The use of integral admixtures and of lacquered instead of oiled forms reduced the penetration, but not enough to be economically adequate. Sodium silicate or magnesium fluosilicate applications were not significantly effective; but plain, well-trowelled plaster coat of cement-sand mortar reduced the rate of penetration of the kerosene to low value. Whether the development of shrinkage cracks on a large surface treated in this manner would nullify these results remains a question. Powdered iron-type admixtures in the mortar coat reduced oil penetration, and one magnesium oxychloride type of coating looked promising if used where exposure to drying or to water is not excessive. This type of coating has the advantages of low cost and easy application. Spar varnish was effective in reducing penetration but would require long time tests to indicate its permanence to such exposures. Polyvinyl chloride type paints and polysulfide emulsified latex linings were effective and are reasonably stable to water, oils, and gasoline. However, these materials are expensive and the cost of applying them is high, so that their use is warranted only under special conditions.

DETERMINING INDIVIDUAL HYDROCARBONS IN MIXTURES

A paper by Anton J. Streiff and Frederick D. Rossini (RP1584) in the May Journal of Research describes a general method for determining individual hydrocarbons in mixtures of hydrocarbons by measurement of freezing points. The method is based on the

fact that the amount of a hydrocarbon H in an unknown mixture of hydrocarbons can be determined by measuring the lowering of the freezing point of a sample of pure H caused by the addition to it of a given amount of the unknown mixture. If the unknown mixture contains none of the hydrocarbon H, the lowering of the freezing point will have its greatest value, which will be substantially that called for by the ideal or dilute solution laws; whereas, if the unknown is composed entirely of the hydrocarbon H, the lowering of the freezing point will be zero.

In the exact application of the method, it is important to show that the solution of the hydrocarbon H with the unknown is, within the desired limits, ideal or sufficiently dilute, so that the ideal law of the lowering of the freezing point may be applied. If the solution of the hydrocarbon H with the unknown is not ideal or sufficiently dilute, it will be necessary to separate the unknown mixture beforehand by an appropriate fractionating process into two or more portions, each of which will form substantially ideal, or sufficiently dilute, solutions with the appropriate pure hydrocarbons.

Experimental data are given for determining each of the four C_6 aromatic hydrocarbons. The uncertainty of the determination of each hydrocarbon is near ± 1 percent of the total sample.

FREEZING AND MELTING CURVES OF HYDROCARBONS

In RP1297 (J. Research NBS 26, 591; June 1941), which deals with time-temperature freezing and melting curves obtained on hydrocarbons, it was shown how, when significant undercooling occurs on freezing, the observations can be analyzed to yield, in proper relation to the subsequent equilibrium part of the curve, the "zero" time, that is, the time at which crystallization would have begun in the absence of undercooling. In that paper, visual extrapolation of the equilibrium part of the curve to "zero" time on freezing and to the corresponding time on melting was used to determine the freezing point, defined as the temperature at which an infinitesimal amount of crystals of the major component is in equilibrium with the liquid.

Now, William J. Taylor and Frederick D. Rossini, in the Journal of Research for May (RP1585) describe a method which may be used either analytically or graphically for extrapolating the equilibrium part of a time-

temperature freezing or melting curve to give the freezing point, T_f , of the given hydrocarbon substance. A description is also included of a method for deducing, within certain wide limits, from the same observations on the given substance, if carried over a sufficiently large fraction of material crystallized or melted, the freezing point for zero impurity, T_{f_0} . When the heat of fusion is known or can be estimated, the value of $T_{f_0}-T_f$ serves to give an estimate of the amount of liquid-soluble impurity in the given substance.

pH OF ACID POTASSIUM PHTHALATE

Buffer solutions prepared with acid potassium phthalate are extensively used for the calibration of commercial pH meters and equipment. A 0.05-m solution is generally employed and is conveniently prepared from the dry salt and distilled water. The pH value of this solution has usually been determined from the measurements of the electromotive forces of galvanic cells comprised of various types of hydrogen and calomel electrodes. The calomel electrode entails the use of a liquid junction, the potential of which cannot be determined on a thermodynamic basis. In the May Journal of Research (RP1586), W. J. Hamer and S. F. Acree describe a method by which the pH of a 0.05-m solution of acid potassium phthalate, prepared from the Bureau's Standard Sample 84a and distilled water, may be evaluated from the measurements of the electromotive forces of galvanic cells without liquid junction. In this method, hydrogen and silver-silver-chloride electrodes are placed in solutions to which known amounts of potassium chloride have been added. Potassium chloride lowers the electromotive force and the pH value of a 0.05-m solution of acid potassium phthalate in almost direct proportion to the increase in the ionic strength of the solution, and the pH of a solution containing no potassium chloride is determined by extrapolation. By this method a 0.05-m solution of acid potassium phthalate is found to have a pH of 4.008 at 25° C. and this value does not vary much with the temperature. The solutions with or without potassium chloride are suitable as standards for pH; their values range from 3.955 to 4.000. Directions are given for their preparation. The application of the method to the determination of the pH and the ionic strength of unknown solutions of low salt content is also de-

scribed. The method may be used in a general study of the effects of salts of various types on the pH of solutions and in particular in the determination of the pH of boiler waters and steam condensates treated with phosphates and starch.

SPECTROPHOTOMETRIC METHOD FOR DETECTING IMPURITIES IN ORGANIC SOLVENTS

In connection with a research project to develop indicators for determining acidity or basicity in hydrocarbons (lubricants, solvents, etc.), Marion E. Maclean, Priscilla J. Jencks, and S. F. Acree investigated the visible and ultraviolet absorption spectra of basic and acidic dyes in benzene and other organic solvents, and the effects produced by adding organic acids or bases. The spectra of dyes are affected by a change of solvent and by impurities in the solutions. It was found that impurities may modify appreciably the ultraviolet absorption spectra of a variety of organic solvents, and that this property provides a means for discovering certain impurities and for observing the effectiveness of different methods of removing them.

In these tests, the transmittancy of a solvent was compared with that of distilled water at different wavelengths (usually at 5-m μ intervals) from 200 m μ to the visible, using a quartz spectrophotometer with absorption cells 1 cm in thickness, and plotting the percentage transmittancy of the solvent against the wavelength.

Absorption curves were obtained for the following solvents in one or more grades of purity: *n*-Heptane, 2,2,4-trimethylpentane, cyclohexane, methylcyclohexane, decahydronaphthalene, tetrahydronaphthalene, benzene, toluene, xylene, chlorobenzene, carbon tetrachloride, ethylene dichloride, trichloroethylene, chloroform, methyl alcohol, ethyl alcohol, *n*-propyl alcohol, isopropyl alcohol, *n*-butyl alcohol, acetone, ethyl acetate, dioxane, dimethyldioxane, diethyl ether, and carbon disulfide.

Marked changes in ultraviolet absorption were observed after filtration of commercial samples of *n*-heptane, 2,2,4-trimethylpentane, cyclohexane, methylcyclohexane, and decahydronaphthalene through a column of silica gel, a process which has been used extensively at the Bureau by F. D. Rossini, B. J. Mair, and associates for removing aromatic and unsaturated compounds in the purification of petroleum hydrocarbons.

Technical benzene gave an absorption band at approximately 320 m μ . However, high-grade commercial benzene gave no band in this region. The transmittancy of the latter was increased in the range 285 to 380 m μ , however, by further treatment; two methods of purification, differing considerably in simplicity, produced the same curve, showing complete absorption of light below 280 m μ . The studies are being extended to the use of absorption cells of less than 1-cm thickness, in order to detect possible variations in the spectra of different samples in the region below 280 m μ .

The effect of impurities was noticeable on the ultraviolet absorption of ethylene dichloride, trichloroethylene, carbon tetrachloride, and chlorobenzene. The curve obtained for a sample of ethylene dichloride which had stood for some time in a colorless bottle differed from that of the original material. Three samples of carbon tetrachloride, all presumably of high grade, gave dissimilar absorption curves. Technical carbon tetrachloride gave a sharp band in the region 320 m μ , which was diminished in intensity after one filtration of the solvent through silica gel.

Distillation or other purification produced marked changes in the absorption curves of the following oxygenated solvents: Acetone, ethyl acetate, dioxane, 95-percent ethyl alcohol. Supposedly pure samples of methyl alcohol, from three sources, gave distinctly different curves.

This spectrophotometric method, in addition to supplying information about the purity and transmittancy of solvents, may also be used in the selection of suitable filters for various regions in the ultraviolet.

COMMERCIAL STANDARD FOR HOSPITAL SHEETING

When the War Production Board found it necessary to curtail the use of rubber, neither crude nor reclaimed rubber was allotted for the manufacture of hospital sheeting for civilian hospitals. Consequently, the employment of rubber substitutes became necessary, with the result that hospital purchasing agents found it increasingly difficult to decide between satisfactory and unsatisfactory materials offered.

In order to provide hospitals with a guide in selecting satisfactory products, the American Hospital Association requested the assistance of the Bureau's Division of Trade Standards in the establishment of a commercial standard. With the cooperation of the lead-

ing manufacturers and a committee of the American Hospital Association, a commercial standard has been prepared and adopted by the industry as Hospital Sheeting for Mattress Protection, Commercial Standard CS114-43. The establishment of the standard was announced November 1, effective from December 1, 1943.

The specification is of the "performance" type, almost complete latitude being allowed the manufacturer in the selection of fabrics and coating or impregnating materials. The standard covers requirements and methods of tests for fabrics coated on both sides or impregnated with a suitable compound, and includes requirements for thickness, breaking strength, tearing strength, resistance to mineral oil and disinfectants, resistance to sterilization, accelerated aging, cracking, and moisture penetration. A burning rate limit is included to prevent the use of flammable materials that would be a fire hazard.

Copies of Commercial Standard CS114-43 are obtainable from Superintendent of Documents, Government Printing Office, Washington 25, D. C. The price is 5 cents.

COMMERCIAL STANDARD FOR OIL-BURNING FLOOR FURNACES

Commercial Standard CS113-44 for oil-burning floor furnaces has just been released. The standard was developed by the industry in cooperation with the Government on request of the Office of Price Administration. It sets forth definitions; requirements for construction, performance, laboratory tests, general installation, venting, publication of furnace ratings, informative labeling, and uniform wording of the manufacturer's guarantee; and gives the wording for the installer's certificate declaring compliance with the commercial standard.

These floor furnaces provide a simple, effective means for automatic heat in areas where oil is normally plentiful. The entire unit is let into the floor between the joists to save living space which might otherwise be occupied by a space heater. Where oil-burning devices are permitted, the standard will provide a basis for guaranteeing effective performance and safety, and should insure fair competition.

The standard became effective for new production on February 17, 1944.

Copies of the pamphlet are available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., at 10 cents each.

THE GRADE TERMINOLOGY PROBLEM

Miscellaneous Publication M173 under the above title, prepared by I. J. Fairchild, chief of the Bureau's Division of Trade Standards, has just been released. This paper sets forth in digest form the grade terms, designations, and bases for grading or rating for 64 commodities and characteristics selected as broadly representative of the various grading and rating systems used in the United States. These terminologies and designations are compared in the light of the technical background for each commodity, and impartially from the viewpoint of the buyer, seller, the inspection or testing agency, enforceability, and provisions for future improvement, in a search for underlying principles and postulates as a general guide in the selection, formulation, or the revision of grade designations in the future.

The author draws five conclusions: (1) Grade terminology and designations have been drawn up by specialists in their particular fields, and are not co-ordinated; (2) there is an underlying complexity that is real and difficult to simplify; (3) in setting up grade designations or terms, provisions should be made for future developments, even those unforeseen and unpredictable improvements that occur in almost every field; (4) a master order of grade terms might well be considered, starting with the lowest present grade at the bottom and proceeding upward toward the ideal, with plenty of room at the top for unforeseen developments; (5) there is room for further coordination, simplification, and study of the underlying principles of grade terminology systems to the end that they may be as simple, consistent, understandable, flexible as regards future developments, and enforceable as possible.

Tables show the systems used for 33 different commodities and characteristics, and a bibliography gives references to many books and articles on the subject. Copies of M173 are obtainable from Superintendent of Documents, Government Printing Office, Washington 25, D. C., at 10 cents each.

RALPH W. SMITH APPOINTED ASSISTANT TO THE DIRECTOR

Ralph W. Smith, for many years chief of the Section on Weights and Measures Administration and more recently of the Section on Large-Capacity Scales, secretary of the National Conference on Weights and Measures, and assistant chief of the Weights and Measures

Division, has been appointed Assistant to the Director of the Bureau in charge of the Administrative Division. In connection with this appointment, Dr. Briggs stated that "inasmuch as the various sections of the Division must of necessity deal directly with the Director's Office in many matters, the position of Chief of the Office Division, which has been vacated through the retirement of Mr. David E. Thomas (Technical News Bulletin No. 324; April 1944), will be abolished, but Mr. Smith will maintain a broad supervisory relationship with these sections as one of his new duties." For the present, Mr. Smith will also continue his work in the field of weights and measures administration and as editor of the Weights and Measures News Letter, 34 numbers of which have been issued to date.

NEW AND REVISED PUBLICATIONS ISSUED DURING APRIL 1944

Journal of Research ²

Journal of Research of the National Bureau of Standards, volume 32, number 4, April 1944 (RP1580 to RP1583 inclusive). Price 30 cents. Annual subscription, 12 issues, \$3.50.

Research Paper ²

[Reprint from the February 1944 Journal of Research]

RP1573. Interpretation of some reactions in the carbohydrate field in terms of consecutive electron displacement. Horace S. Isbell. Price 5 cents.

Simplified Practice Recommendations ²

R31-44. Loaded paper shot shells. Price 5 cents.

R60-43. Packaging of carriage, machine, and lag bolts. Price 5 cents.

R62-44. Metallic cartridges. Price 5 cents.

Commercial Standard ²

CS113-44. Oil-burning floor furnaces equipped with vaporizing pot-type burners. Price 10 cents.

² Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Subscription to Technical News Bulletin, 50 cents a year; Journal of Research, \$3.50 a year (to addressees in the United States and its possessions and in countries extending the franking privilege); other countries, 70 cents and \$4.50, respectively.

Miscellaneous Publications ²

M173. The grade terminology problem. Her J. Fairchild. Price 10 cents.

M174. American standard building code requirements for masonry. Price 10 cents.

Technical News Bulletin ²

Technical News Bulletin No. 324, April 1944. Price 5 cents. Annual subscription, 50 cents.

MIMEOGRAPHED MATERIAL

Letter Circulars

[Letter Circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards and are sent only on request to persons having a definite need for the information. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or send copies automatically as issued.]

LC745. List of commercial standards. (Supersedes LC742).

LC746. Paints for swimming pools.

LC747. Painting exterior walls of porous masonry.

RECENT ARTICLES BY MEMBERS OF THE BUREAU'S STAFF PUBLISHED IN OUTSIDE JOURNALS ³

Thermometry. Johanna Busse. Chapter beginning on p. 1555 of book entitled "Medical Physics", edited by Otto Glasser (Yearbook Publishers, 304 South Dearborn St., Chicago, Ill.) (March 1944).

Color vision. Deane B. Judd. Chapter beginning on p. 265 of book entitled "Medical Physics" (March 1944).

Discussion: Significance of the secant and tangent moduli of elasticity in structural design—Don S. Wolford. W. R. Osgood. J. Aeronautical Sciences (1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N. Y.) 11, No. 1, 91 (January 1944).

² Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Subscription to Technical News Bulletin, 50 cents a year; Journal of Research, \$3.50 a year (to addressees in the United States and its possessions and in countries extending the franking privilege); other countries, 70 cents and \$4.50, respectively.

³ These publications are not obtainable from the Government, unless otherwise stated. Requests should be sent direct to the publishers.

- Plastics: Organic. Frank W. Reinhart and Gordon M. Kline. Chapter beginning on p. 1101 in book entitled "Medical Physics" (March 1944).
- The variation of the strength, resistance to oxidation and electrical conductivity of metals with temperature. D. J. McAdam and G. W. Geil. Trans. Am. Soc. for Metals (7301 Euclid Ave., Cleveland, Ohio) 33 (1944).
- A precision apparatus for the rapid determination of indices of refraction and dispersion by immersion. Conrad A. Faick and Bernard Fonoroff. Glass Industry (55 West 42d St., New York 18, N. Y.) 25, No. 3, 110 (March 1944).
- Keep simplified practice working. Edwin W. Ely. Mid-Continent Purchaser (Tulsa, Okla.) 24, No. 7, 6 (April 1, 1944).

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